DELAWARE RIVER BASIN
SOUTH BRANCH RANCOCAS CREEK
BURLINGTON COUNTY,
NEW JERSEY

VINCENTOWN MILL DAM
NJ 00396

LEVEL II

AD A089078

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

ORIGINAL CONTAINS COLOR PLATES: ALL DDC
REPRODUCTIONS WILL BE IN BLACK AND WHITE

MARCH 1980

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NJ00396	2. GOVT ACCESSION NO.: AD-A089 078
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Phase I Inspection Report National Dam Safety Program Vincentown Mill Dam NJ00396 Burlington County, N.J.	5. TYPE OF REPORT & PERIOD COVERED: FINAL
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): RULDOLPH WRUBEL, P.E.	8. CONTRACT OR GRANT NUMBER(s): DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Louis Berger & Associates Inc. 100 Halstead St. East Orange, N.J. 07019	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625	12. REPORT DATE: March, 1980 13. NUMBER OF PAGES: 57
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office): U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106	15. SECURITY CLASS. (of this report): Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
Embankments
Visual Inspection
Structural Analysis
National Dam Safety Program
Vincentown Mill Dam, N.J.
Spillways
Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(9) Final Rept. (10) Rudolph/Wrubel (11) Mar 80

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

(6) National Dam Safety Program. Vincentown Mill Dam (NJ00396) Delaware River Basin, South Branch Rancocas Creek, Burlington County, New Jersey. Phase I Inspection Report.

25-AUG-1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

(15) DACW61-79-C-0021 (12) 73

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Vincentown Mill Dam in Burlington County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Vincentown Mill Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's two spillways are considered inadequate because a flow equivalent to 14 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway inadequate instead of seriously inadequate is based on the determination that failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just prior to overtopping. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within three months from the date of approval of this report, the following remedial actions should be initiated:

(1) Continue treating the minor erosion of the embankment side slopes and repair the downstream retaining walls.

(2) Scour below the main spillway outlet should be countered by placement of riprap.

(3) Repair major cracks in the concrete spillway structures and repair the Armco lift gates.

410.50

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. The owner should develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Forsythe of the Sixth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the state to implement our recommendations.

Sincerely,

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
for District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

VINCENTOWN MILL DAM (NJ00396)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 November and 24 December 1979 by Louis Berger and Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Vincentown Mill Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's two spillways are considered inadequate because a flow equivalent to 14 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway inadequate instead of seriously inadequate is based on the determination that failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just prior to overtopping. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within three months from the date of approval of this report, the following remedial actions should be initiated:

(1) Continue treating the minor erosion of the embankment side slopes and repair the downstream retaining walls.

(2) Scour below the main spillway outlet should be countered by placement of riprap.

(3) Repair major cracks in the concrete spillway structures and repair the Armco lift gates.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. The owner should develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED: _____

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 21 Aug 80

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Vincentown Mill Dam Fed ID# 00396
NJ ID# 32-4

State Located New Jersey
County Located Burlington
Coordinates Lat. 3956.1 - Long. 7445.1
Stream South Branch Rancocas Creek
Date of Inspection 11/12/79, 12/24/79

ASSESSMENT OF GENERAL CONDITIONS

Vincentown Mill Dam is assessed to be in a fair overall condition. Uncertainty with respect to the operation of the timber flashboards necessitates additional operational investigation to ascertain continued satisfactory performance and further studies are recommended regarding the overall hydraulics of this site in conjunction with other restrictions on this creek. Remedial actions recommended to be undertaken in the future include the patching of the concrete in the spillways and slope protection of the eroded areas of the side slopes. The Armco sluice gates should also be renovated if feasible.

The combined spillways are inadequate and can transmit only 13% of the 0.5 PMF design flood, but the dam is not assessed as unsafe, non-emergency for this reason as the existing conditions do not meet the requirements of ETL 1110-2-234 in the opinion of the inspection team in that failure resulting from overtopping would not significantly increase the hazard to loss of life from that which would exist just before overtopping failure.

Rudolph Grubel
Vice President
Louis Berger & Associates, Inc.

OVERVIEW OF VINCENTOWN MILL DAM

December, 1979

TABLE OF CONTENTS

FIGURES

APPENDIX

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION PROJECT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: VINCENTOWN MILL DAM FED #NJ00396

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Vincentown Mill Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Vincentown Mill Dam is an 88 year old earth roadway embankment approximately 400 feet in length, with two bridged spillways. The principal (east) spillway consists of a concrete highway culvert with six 4 foot wide hand-operated vertical-lift timber gates. An old mill raceway spillway is located at the west end of the dam which consists of a gated concrete arch culvert that discharges into a separate mill race. It has an overall waterway opening approximately 16 feet wide. The asphalt paved Race St. passes over the dam crest.

b. Location

Vincentown Mill Dam is located on the South Branch of the Rancocas Creek in South Hampton Township,

Burlington County, New Jersey. The dam lies in the center of the town of Vincentown and is approximately 3-1/2 miles due north of the intersection of Route 70 and Route 206.

c. Size Classification

The maximum height of the dam is twelve feet and the maximum storage is 557 acre-feet. Therefore, the dam is placed in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams (storage impoundment less than 1,000 acre-feet and height less than 40 feet.)

d. Hazard Classification

Based on Corps of Engineers criteria and the fact that in the event of a failure, excessive damage could occur to downstream properties together with a signficant potential for loss of more than a few lives, the dam is classified in the high hazard category. Immediately downstream there are several homes and businesses and two bridges on Mill Street, just a few hundred feet downstream from the study dam.

e. Ownership

The dam is owned and maintained by Southampton Township, Mount Holly, New Jersey, 08060. The Township Engineer is Wills, Anderson & Lord, Mount Holly - Lumberton Road, Mount Holly, New Jersey, 08060.

f. Purpose of Dam

The dam presently impounds a recreation lake. Further downstream there is evidence of an old grist mill and the original purpose of the dam was to provide power for a waterwheel.

g. Design and Construction History

Little information is available pertaining to the history of the dam. Division of Water Resources reference data indicated that the original dam was built in 1891 and the main spillway bridge was erected in 1917-19. On January 6, 1924, the dam was breached at the right hand bridge abutment. It is unknown, however, whether repairs were immediately made. In July 1933 a gate post on the main spillway was repaired and other minor

modifications were performed. In 1960, repairs were made to the main gate structure. The extent of these repairs, however, is unknown.

From information on a nameplate, the auxiliary raceway bridge was erected in 1911 and it appears the gristmill was located a considerable distance downstream.

h. Normal Operating Procedures

Personnel of the Township normally attend to the operating facilities and conduct maintenance (see Section 4).

1.3 PERTINENT DATA

a. Drainage Area

Vincentown Mill Dam has a drainage area of 52 square miles.

b. Total combined spillway capacity at maximum pool elevation - 777 cfs.

c. Elevations (ft. above MSL)

Top of dam - +27
Recreation pool - +23
Streambed at centerline of dam - +16

d. Reservoir

Length of maximum pool (top of dam) - 2800 feet
Length of recreation pool (main spillway crest) - 2500 feet

e. Storage (acre-feet)

Top of dam - 557
Recreation pool - 107

f. Reservoir Surface (acres)

Top of dam - 186
Recreation pool - 39

g. Dam

Type - Earth embankment with 2 gated spillways
Length - 400 ± feet

Hydraulic height - 11 feet
Structural height - 12 feet
Top width - 30 feet
Side slopes - 6H:1V
Zoning - unknown

h. Diversion and Regulating Tunnel - none

i. Spillways

1. Main

Type - concrete roadway culvert with timber gates
Length of weir - 23 feet (effective opening)
Crest elevation - +23 MSL
U/S channel - main lake reservoir
D/S channel - heavily wooded natural riverbed

2. Spillway (Raceway)

Type - concrete arch with timber flashboards
Length of weir - 14.25 feet (effective opening)
Crest elevation - 23 M.S.L.
U/S channel - old raceway channel with concrete retaining wall on west bank
D/S channel - well defined millrace with deteriorated timber bulkhead on east bank

j. Regulating Outlets - none (2 Armco lift gates on main spillway inoperable).

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The only design information located for review were the 1960 reconstruction plans for the Armco sluice gates in the main spillway. The original configuration of the dam before the reconstruction is unknown. The work was designed by Mr. B. Harold Wills, Southhampton Township Engineer. There are no design computations or record plans available for the spillway culverts.

2.2 CONSTRUCTION

No information was available except that the main spillway bridge structure was built in 1917 by the Medford Concrete Company and the raceway bridge was designed by Earl Thomson and constructed by the Ferro Concrete Company of Harrisburg, Pa. at some unknown date.

2.3 OPERATION

See Section 4.

2.4 EVALUATION

a. Availability

In view of the size and structural conditon of the dam, it is felt that sufficient engineering data was obtained to adequately assess the overall condition, safety and hydraulic characteristics. No data was uncovered regarding the composition of the embankments. The dam is located near the easterly limit of the inner zone of the Coastal Plain physiographic province and lies within a narrow strip of land where the surficial soils are comprised of recent alluvium with a wide range of grain sizes occuring in intermingled layers. To the west are the silty sands of the Cape May and Bridgetown formations which have a relatively uniform gradation but are intermixed with some gravel. The surficial soils adjacent to the east side of the alluvial belt are comprised of interbedded silts, silty sands and silty and clayey sands and gravels of the Cape May, Pennsauken and Bridgeton formations. Stratified marine deposits comprised of silty and clayey sand interbedded with sandy clay underlie

the dam and the other surficial soil formations in this area. These marine soils, which are likely to occur at depths less than ten feet on the east side of the lake and may outcrop in some areas west of the lake, include soils of the Vincentown, Mount Laurel, Wenonah, Marshaltown and Englishtown formations.

c. Validity

The validity of the record plans is not challenged and is accepted without recourse to further investigations.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection was conducted on November 12, 1979, at which time Vincentown Lake was close to its normal water elevation. Water was flowing freely several inches above the boards of two central openings of the total of six at the main spillway, and only a little shallower through all three gates of the auxiliary mill race gate. The very active flow combined with high downstream water levels prevented a closer examination of either structure.

b. Dam

The embankment which forms the major part of the dam is topped with the two lane asphalt pavement of Race Street. Except for areas near and to the right of the main bridge it seems to differ little in elevation from the surrounding ground. In appearance it is fairly solid and stable with gentle, grass covered slopes. However, there is minor settlement of the right hand approach fill, slight shifting of the wingwalls, and some erosion behind it. There is a lengthy but factually unconfirmed history of breaching here, and evidence of countermeasures including asphalt curbing and drainage outlets along both upstream and downstream crests and some attempt to control erosion at both wingwalls. The downstream slope to the left, supports many large trees but seems stable. Slight settlement is also evident at the right abutment of the auxiliary spillway and measures have been taken to control erosion on both sides by placing an asphalt surface, installing timber retaining walls, or both. There are many homes and other buildings downstream of the two spillways, especially to the left of the main channel.

c. Appurtenant Structures

Both spillway culverts show their age, the main structure being 62 to 70 years old including some modifications after original construction, and the

smaller one over the race just 68. There is cracking on wingwalls but little spalling of concrete of the main bridge. The other shows some larger vertical cracks at joints and waterline spalling. Both, however, appear to retain generally good horizontal and vertical alignment and to be at least acceptable in condition. The timber gate structures are more vulnerable and exhibit some shortcomings in spite of being only about 20 years old. They seem to be relatively sound in condition and attitude, but the two mechanical gates within the main spillway are apparently not functioning at the present time.

d. Reservoir

Vincentown Lake has stable banks well covered with vegetation, and scattered homes at or near its shores at least two to six feet above water level at the time of inspection. The lake appeared to be clear and free of debris, but is possibly subject to some accumulation from its wooded upstream sources during storm runoff. The mill race is confined in a narrow channel with a concrete wall and private home along its west bank.

e. Downstream Channel

Both the main stream and the mill race continue through much of Vincentown in fairly restricted channels. They then rejoin a little more than 0.3 of a mile downstream in a broader, natural floodplain. Immediately downstream of the main dam there is a large stilling basin, about 100 feet wide, which was running above bank full during inspection. The adjoining road and some buildings to its right are low and reportedly subject to repeated effects of high water. The mill race is confined by timber retaining walls, some parts being in poor condition. Differential head as observed was approximately 3.5 feet at the main dam and 2 feet at the race. Both streams pass under bridges some 150 yards downstream that are not quite as old as those at the dam but which are in poor condition. Normal flows at these points are slow in the main stream but fairly high in the millrace. Homes along and between the heavily wooded, confined channels also suffer some effects of flooding as this portion of the village is all within the low-lying flood plain.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed by the inspection team. Operational activities are confined to raising the two gates and removal of flashboards during periods of spring floods and for occasional reservoir maintenance.

4.2 MAINTENANCE OF DAM

The dam is periodically inspected and repairs undertaken as required.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operating features are the two Armco sluicegates in the main spillway which reportedly are inoperable at the present time.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

None exists except for monitoring by township and county personnel during heavy storms.

4.5 EVALUATION

The present operations are deemed adequate in view of the overall height of dam and the limited capacity of the spillways. Much of the surrounding town is subject to low levels of flooding regardless of the dam's hydraulic operation. Consequently, until such time as the overall flooding conditions are improved, both upstream and downstream, the operational procedures at this dam have little effect on the overall flooding conditions.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

In accordance with the criteria in the Recommended Guidelines for Safety Inspection of Dams, it has been determined that Vincentown Mill Dam is small in size but placed in the high hazard category. Accordingly, the spillway design flood (SDF) was determined by the inspection team to be one-half the probable maximum flood (PMF). The inflow hydrograph was calculated using precipitation data from Hydrometeorological Report #33.

In accordance with Corps of Engineers directives, the inflow hydrograph and flood routing were performed utilizing the HEC-1 computer program. Peak inflow for the 1/2 PMF was 6,261 cfs. When routed through the reservoir the peak reduced slightly to 6,187 cfs. The spillway capacity before overtopping occurs is 777 cfs and thus can accommodate only 13% of the spillway design flood.

b. Experience Data

Hearsay information reveals that the dam crest has been repeatedly overtopped in the past but has not suffered a serious breaching since 1924. However, very recently a private home which stood south of the dam between the main channel and millrace was demolished after suffering flood damage. According to early Bureau of Water Control records, the 50 year flood at this site was calculated to be 1050 cfs and the spillways were judged to be inadequate.

c. Visual Observations

During the periods of heavy flow, downstream constrictions create an ever-increasing tailwater condition which tend to minimize the damage of high flows through the study dam, i.e. that spillways become submerged and their contribution to flooding is diminished. Overtopping, therefore, does not add appreciably to the flood levels within the surrounding community.

d. Overtopping Potential

The hydraulic analysis indicates a major potential for early overtopping is due to the limited capacity of the spillways. However, after flood waters crest above roughly three feet, the natural river channel becomes more severely restricted by steeper side slopes and allows only about 300 feet of widening. At this crest, a considerable portion of the downstream community is flooded but the dam constriction adds little to the crest elevation as the entire structure is submerged by high tailwater conditions from downstream restrictions.

e. Drawdown

Drawdown can be accomplished by opening the two Armco sluicegates and it is calculated that it would take approximately one half day to dewater the lake.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

The dam embankment is deemed to be in good condition except for minor erosion behind the downstream wingwalls of the bridge over the main channel. No seepage was noted, and potential problems should relate primarily to overtopping and possible subsequent erosion. The concrete bridges, although old, seem also to be relatively sound. Timber spillway gates at both locations have been repaired at times, and are apparently stable in themselves and in their attachment to the concrete structures.

b. Design and Construction Data

Limited design data was available, and no specific detail on construction, so the structural stability analysis is based almost entirely on field observations.

c. Operating Records

No formal records have been maintained and operations have consisted principally of adjusting the flashboards.

d. Post Construction Changes

There are no clear records of significant post construction changes except for normal maintenance and upkeep. Some slight increase in embankment stability should follow the addition of roadway curbs and drains.

e. Seismic Stability

The dam is located in Earthquake Zone 1 and has negligible damage vulnerability due to its low height i.e. it is stable under all loading conditions. Experience indicates that dams in Zone 1 will have adequate stability under dynamic loads if stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Vincentown Lake Dam is classified as being in fair overall condition insofar as its embankment is concerned. The concrete portions of the two spillways are also sound, and the timber gates in reasonably satisfactory condition but in need of attention. The spillways are inadequate hydraulically, being capable of accommodating 13% of the 1/2 PMF design flood even when in fully effective operating shape. However, the dam is not assessed as unsafe, non-emergency as existing conditions do not meet the requirements of ETL 1110-2-234 in the opinion of the inspection team in that failure resulting from overtopping would not significantly increase the hazard to loss of life from that which would exist just before overtopping failure. The overtopping potential is considerable, and damage to either the embankment or spillway gates could cause damage to that portion of the town directly downstream. Improvements in analysis of dam requirements, condition and operation of spillway gates, and planning and implementation of necessary modifications to structures and their function are recommended as per para. d below.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the structural stability of the dam. However, no inspection or reviews have been recorded since 1960.

c. Urgency

A failure of Vincentown Mill Dam could endanger life and property in the community and consequently further studies are recommended in the near future in addition to remedial measures set forth below.

d. Necessity for Further Study

Due to the high hazard classification and the possibility of severe damage likely in the event of a failure, further studies are recommended. While they should encompass more in-depth structural inspection of the spillways, it is believed that they should be concerned more with hydraulic/hydrologic characteristics especially the downstream channel restrictions.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Recommendations

1. An in-depth thorough hydraulic/hydrologic study should be initiated to accurately derermine the current overall requirements for the effective and safe function of Vincentown Mill Dam. This should combine details of present behavior of the entire upstream system of the South Branch of the Rancocas Creek, seasonally and in time of storms, using available historical accounts and measurements. It should also take into account the effects of downstream obstructions and instances of dam distress and flooding in the past. On the basis of these studies, remedial improvements to the existing spillways can be better planned and designed. A rational basis can also be developed for scheduling such improvements.

2. The minor erosion of the embankment side-slopes should continue to be treated, and downstream retaining walls should be repaired.

3. Scour below the main spillway outlet should be countered by placement of riprap.

4. Repair major cracks in spillway concrete structures and repair Armco lift gates.

b. O&M Maintenance and Procedures

In the near future the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

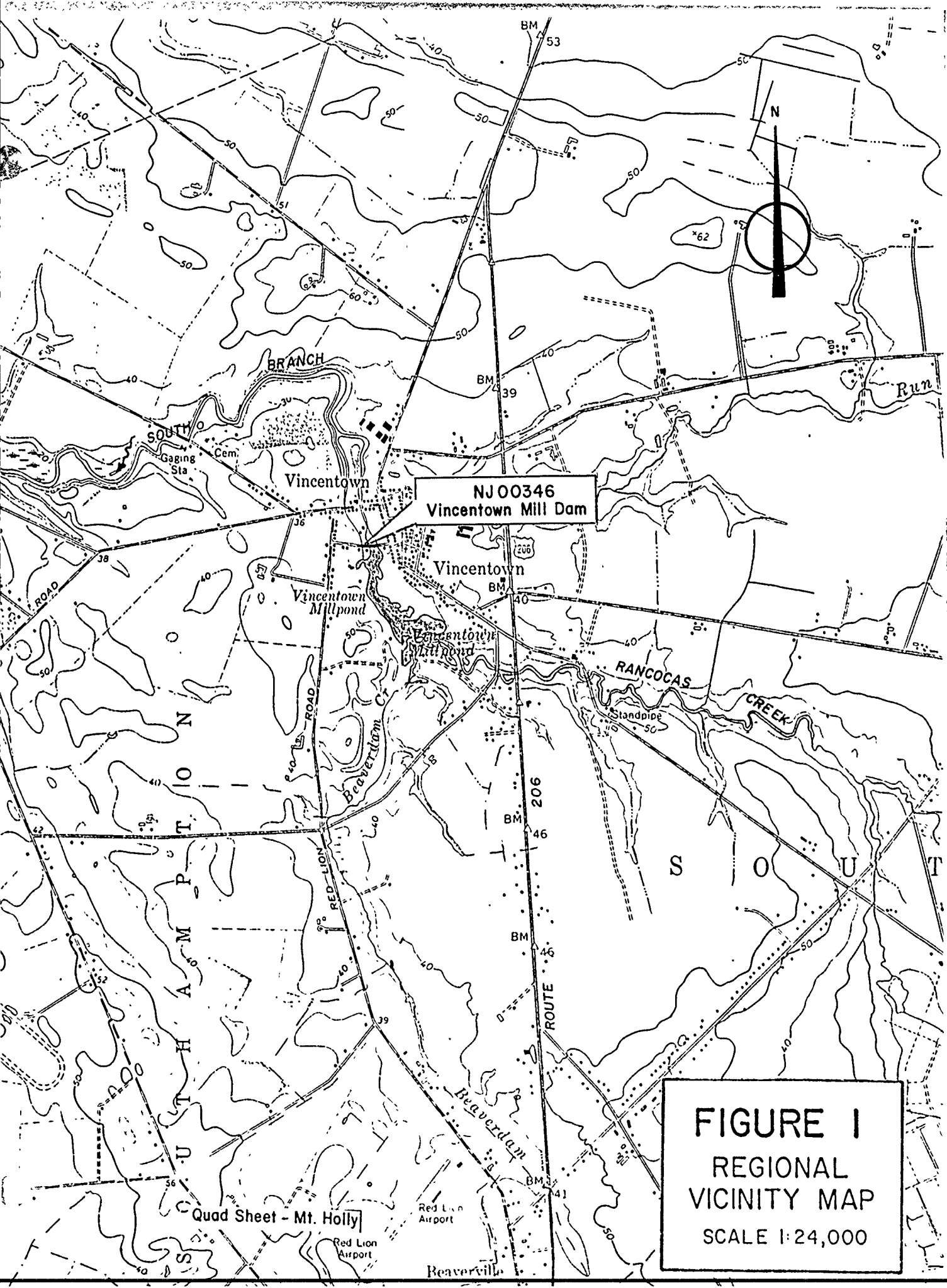
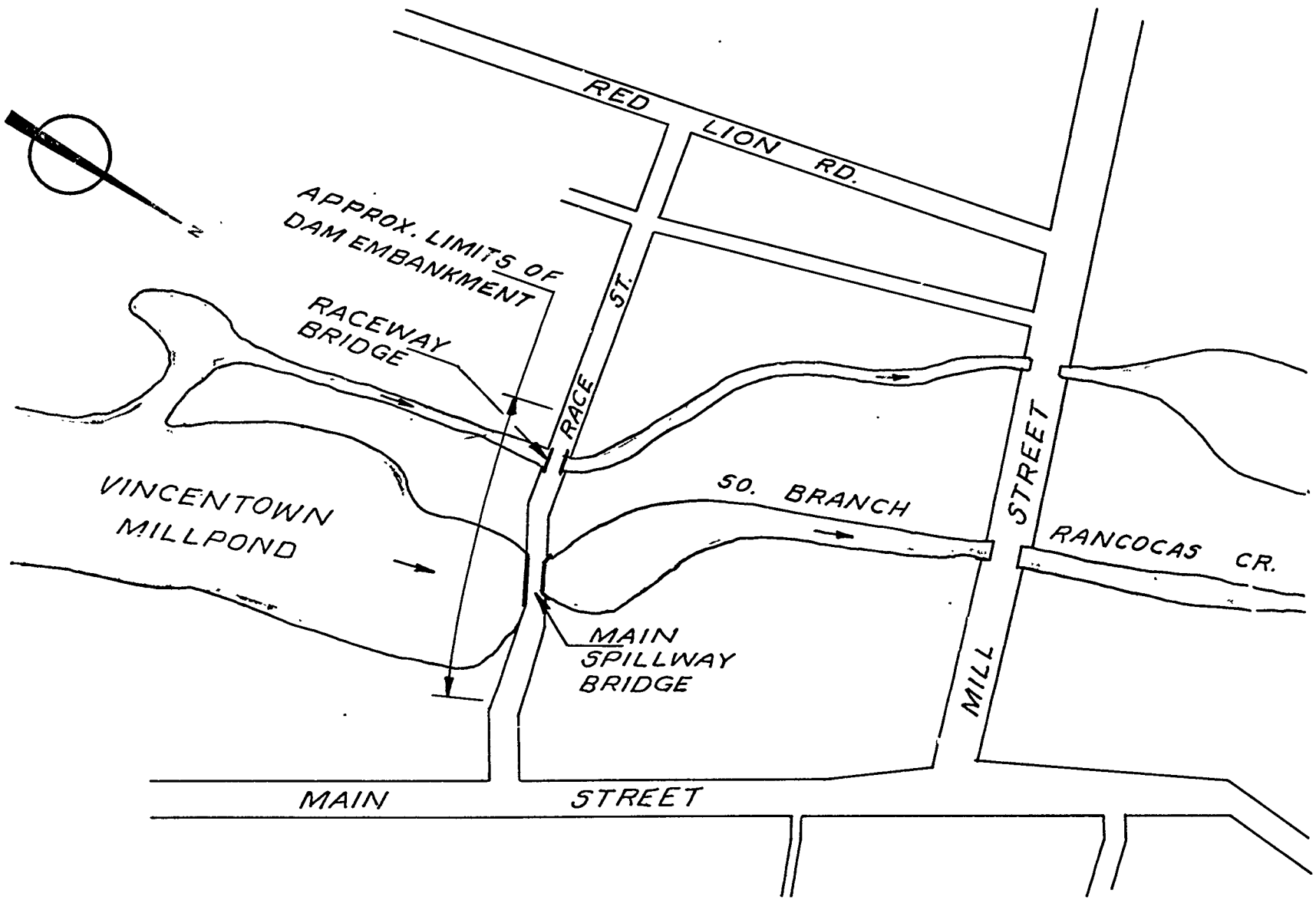


FIGURE 1

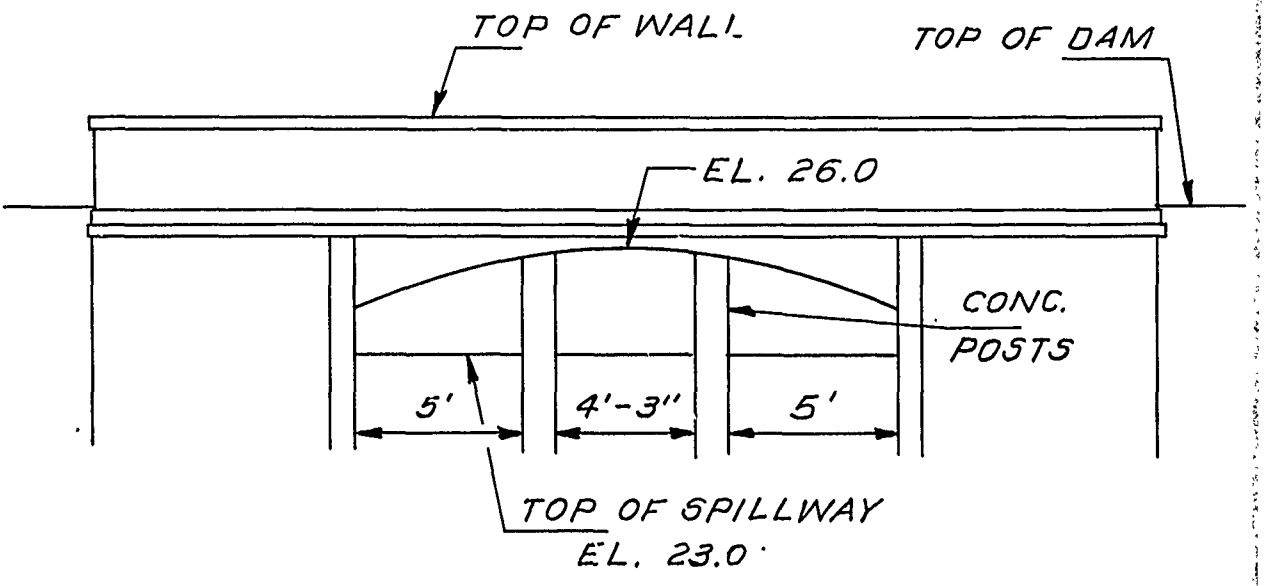
REGIONAL VICINITY MAP

SCALE 1:24,000



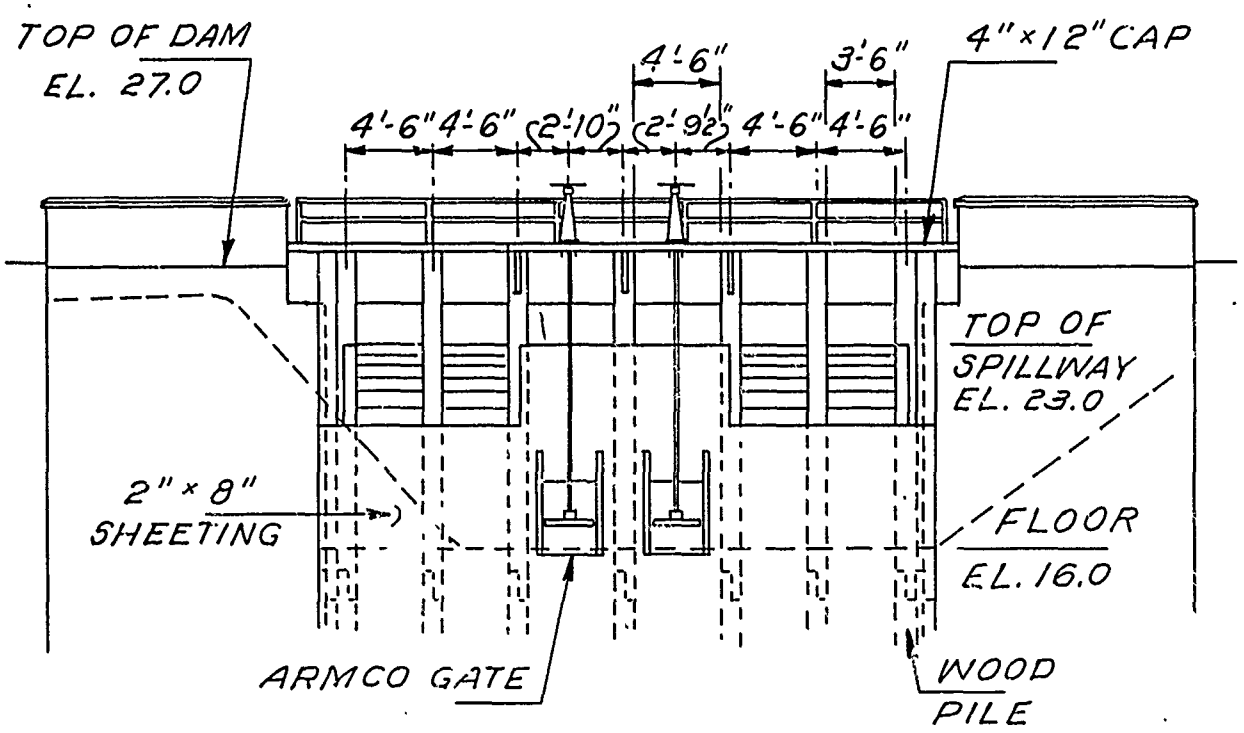
PLAN OF DAM

FIGURE 2

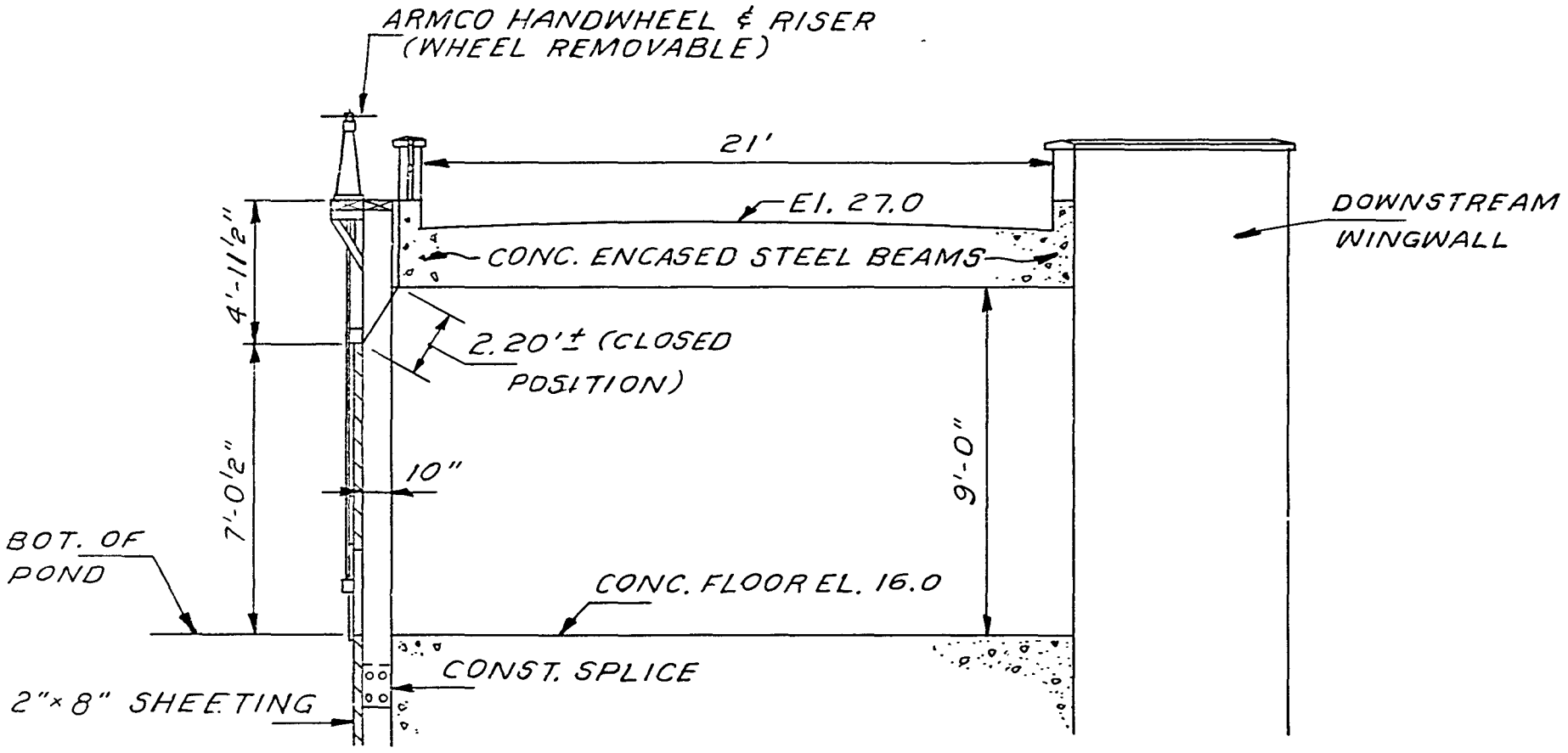


UPSTREAM VIEW-RACEWAY BRIDGE

NOT TO SCALE



UPSTREAM VIEW-MAIN SPILLWAY



SECTION THRU MAIN SPILLWAY BRIDGE

NOT TO SCALE

FIGURE 4

Check List
Visual Inspection
Phase 1

Name Dam Vincentown Mill County Burlington State New Jersey Coordinators N.J.D.E.P.

Date(s) Inspection 11/12/79 12/24/79 Weather Clear Temperature 50°F

Pool Elevation at Time of Inspection 23.2 M.S.L. Tailwater at Time of Inspection 19.4 M.S.L.

Inspection Personnel:

J. Voorhees E. Simmone

K. Jolls D. Lang

L. Baines

D. Lang Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Local street bridge structure Main structure built 1917 City Engr. William Thackary Contrs. Medford Concrete Co.	Raceway bridge built 1911 Earl Thomson Engr. Ferro Concrete Co. Bldrs.
DRAINS	None	
WATER PASSAGES	None	
FOUNDATION	Probable timber piling (in view of lack of differential settlement).	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Local street bridge structure Main structure built 1917 City Engr. William Thackary Contrs. Medford Concrete Co.	Raceway bridge built 1911 Earl Thomson Engr. Ferro Concrete Co. Bldrs.
DRAINS	None	
WATER PASSAGES	None	
FOUNDATION	Probable timber piling (in view of lack of differential settlement).	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Numerous cracks evident particularly on wingwalls.	Large vertical cracks at joints at west side of mill race structure.
STRUCTURAL CRACKING	None apparent	
VERTICAL AND HORIZONTAL ALIGNMENT	Horizontal alignment good, roadway embankment vertical, fair, some elevation differential at end of slab.	
MONOLITH JOINTS	None	
CONSTRUCTION JOINTS	Poured concrete wingwalls, all sides	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None evident	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Asphalt patching apparent on SW side of spillway Erosion from street runoff appears to be a problem. Continuing runoff erosion on NW side of main structure. Erosion from runoff at 3 corners of mill race structure Asphalt patching evident.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	good, roadway embankment 12" - 14" ø trees on d/s slope	
RIPRAP FAILURES	no riprap evident	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Extruded asphalt curbing placed with guardrail on NW side, regraded to channel wall back about 60 feet to paved ditch drain.	See plans.
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAGE AND RECORDER	None apparent.	
DRAINS	None seen.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Concrete in good condition.	Concrete on mill race structure has heavy spalling.
INTAKE STRUCTURE		
OUTLET STRUCTURE		
OUTLET CHANNEL		
EMERGENCY GATE		

	GATED SPILLWAY MAIN STRUCTURE	MILL RACE
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Creosoted timber frame bolted to concrete structure, moderately good condition, some dry rot.	
APPROACH CHANNEL	Vincentown Lake.	Channel for mill race approximately 20 feet wide with an 85 foot long concrete wall along southside protecting residence. Large (40"$\pm$ Ø) tree at SE wing wall.
DISCHARGE CHANNEL	See downstream channel.	See d/s channel.
BRIDGE AND PIERS	5-piers for timber flashboards flashboards in place.	2-piers for flashboards Some timber flashboards in place.
GATES AND OPERATION EQUIPMENT	2-hand operated gates, inoperative.	Gates should be repaired.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	gentle slope, lightly covered with brush and trees in some areas.	
SEDIMENTATION	minor	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	none immediately below dam	Mill race 20^{+} wide heavily wooded on both sides deteriorated timber bulkhead north side to 70 feet below dam structure
SLOPES	Very flat on both sides Large, stilling area immediately d/s of spillway. Local Fire Department d/s on North side sits very low —	several homes appear to be continuously flooded during storm
APPROXIMATE NO. OF HOMES AND POPULATION	1) 3 - 4 immediately Cty Bridge No. 192 below main spillway Built 1918, 37 feet wide Cty Engr. James Logan The Juniata Co. Builders 2) County Bridge No. 191 downstream of mill. mortared stone substructure poor condition, high velocity flow 13.5 feet wide	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Not available.
REGIONAL VICINITY MAP	Available - USGS Quad - Mt. Holly
CONSTRUCTION HISTORY	Not available.
TYPICAL SECTIONS OF DAM	Not available.
HYDROLOGIC/HYDRAULIC DATA	Not available.
OUTLETS - PLAN	June, 1960 Reconstruction plans available - NJDEP Division of Water Resources - Bureau of Flood Plain Management - Trenton, N.J.
- DETAILS	Not available.
-CONSTRAINTS	Not available.
-DISCHARGE RATINGS	Not available
RAINFALL/RESERVOIR RECORDS	Gaging station located downstream of dam - # 01465850

ITEM	REMARKS
SPILLWAY PLAN	1960 Reconstruction Plans - NJDEP
SECTIONS	1960 Reconstruction Plans - NJDEP
DETAILS	Not available.
OPERATING EQUIPMENT PLANS & DETAILS	Not available.

ITEM	REMARKS
DESIGN REPORTS	Not available.
GEOLOGY REPORTS	Not available.
DESIGN COMPUTATIONS	Not available.
HYDROLOGY & HYDRAULICS	Not available.
DAM STABILITY	Not available.
SEEPAGE STUDIES	Not available.
MATERIALS INVESTIGATIONS	Not available.
BORING RECORDS	Not available.
LABORATORY	Not available.
FIELD	Not available.
POST-CONSTRUCTION SURVEYS OF DAM	Not available.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown.
HIGH POOL RECORDS	Unavailable.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not available.
PRIOR ACCIDENTS OR FAILURE OF DAM	Not available.
DESCRIPTION	Not available.
REPORTS	Not available.
MAINTENANCE OPERATION RECORDS	Not available.

November, 1979

View of Crest Looking West

November, 1979

View of Erosion to Right of Main Spillway

November, 1979

Upstream View of Main Spillway

November, 1979

Downstream Channel of Main Spillway

November, 1979

View of Millrace Spillway

November, 1979

View of Timber Bulkhead Downstream Millrace Spillway

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 52 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 23 MSL (107 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY):

ELEVATION MAXIMUM DESIGN POOL: 27 MSL (557 acre-feet)

ELEVATION TOP DAM: 27 MSL

CREST:

a. Elevation 27 MSL
b. Type Earth embankment with two concrete spillways
c. Width 30 feet
d. Length 400± feet
e. Location Spillover At each abutment
f. Number and Type of Gates

OUTLET WORKS: main spillway

a. Type concrete roadway culvert
b. Location right abutment
c. Entrance inverts 23 MSL
d. Exit inverts 16 MSL
e. Emergency draindown facilities timber flashboards

HYDROMETEOROLOGICAL GAGES: Hydro unit #01465850
a. Type Water stage recorder
b. Location Downstream on Lumberton-Vincentown Road
c. Records 1961-1975

MAXIMUM NON-DAMAGING DISCHARGE: 777 cfs

BY. LB DATE 12-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-1 OF

CHKD. BY DATE VINCENTOWN MILL DAM PROJECT C-246

SUBJECT

DRAINAGE AREA - 52 SQUARE MILES

SNYDER COEFFICIENTS (FROM CORPS OF ENGINEERS)

$T_p = 13.1$

$C_p = 0.23$

PRECIPITATION DATA (FROM HYDROMETEORLOGICAL REPORT #3

PMP FOR 24 HOURS AND 200 SQUARE MILES ≈ 23.6"

MAX 6 HOUR PERCENTAGE = 97%

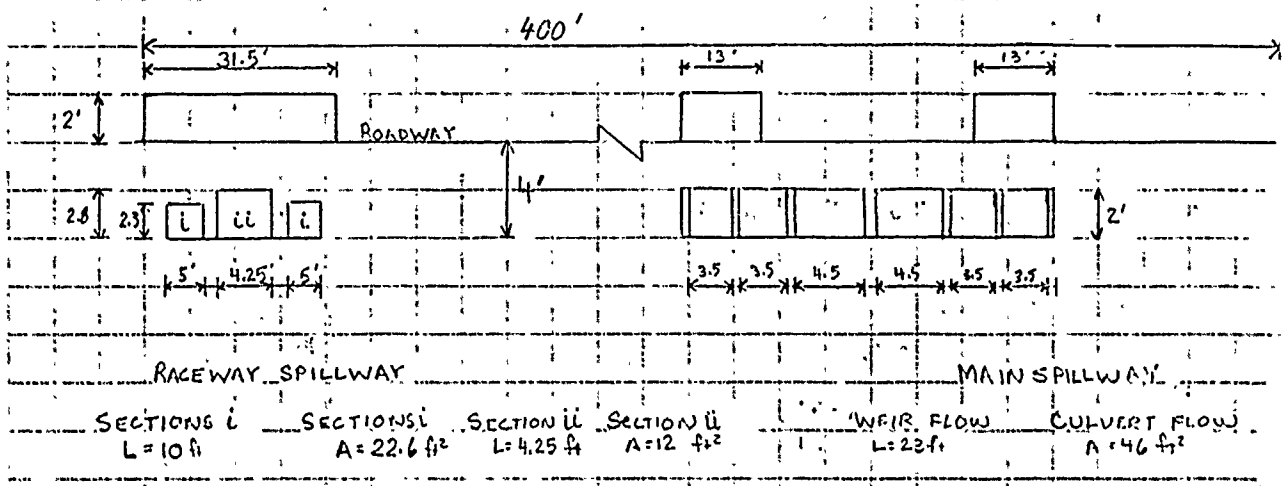
MAX 12 HOUR PERCENTAGE = 106%

MAX 24 HOUR PERCENTAGE = 128%

BY L.B. DATE 12-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-2 OF

CHKD. BY DATE VINCENTOWN MILL DAM PROJECT C-24

SUBJECT SPILLWAY DISCHARGE



ELEV. (MSL)	H	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q
23	0												
23.5	.5	3.1	.11			3.1	.5			3.1	.25		
24	1	3.1	.31			3.1	13			3.1	.71		
24.5	1.5	3.1	.57			3.1	24			3.1	131		
25	2	3.1	88			3.1	37					.6	313
25.5	2.5			.6	172	3.1	52					.6	350
26	3			.6	188			.6	100			.6	384
26.5	3.5			.6	204			.6	108			.6	414
27	4			.6	218			.6	116			.6	443
27.5	4.5			.6	231			.6	123			.6	470
28	5			.6	243			.6	129			.6	495
28.5	5.5			.6	255			.6	136			.6	519
29	6			.6	267			.6	142			.6	543
29.5	6.5			.6	277			.6	147			.6	565
30	7			.6	288			.6	153			.6	587
30.5	7.5			.6	293			.6	158			.6	607
31	8			.6	308			.6	163			.6	626

BY L.B. DATE 4-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-3 OF

CHKD. BY DATE VINCENTOWN MILL DAM PROJECT C-246

SUBJECT SPILLWAY DISCHARGE

FLOW OVER DAM (BROAD CRESTED WEIR)

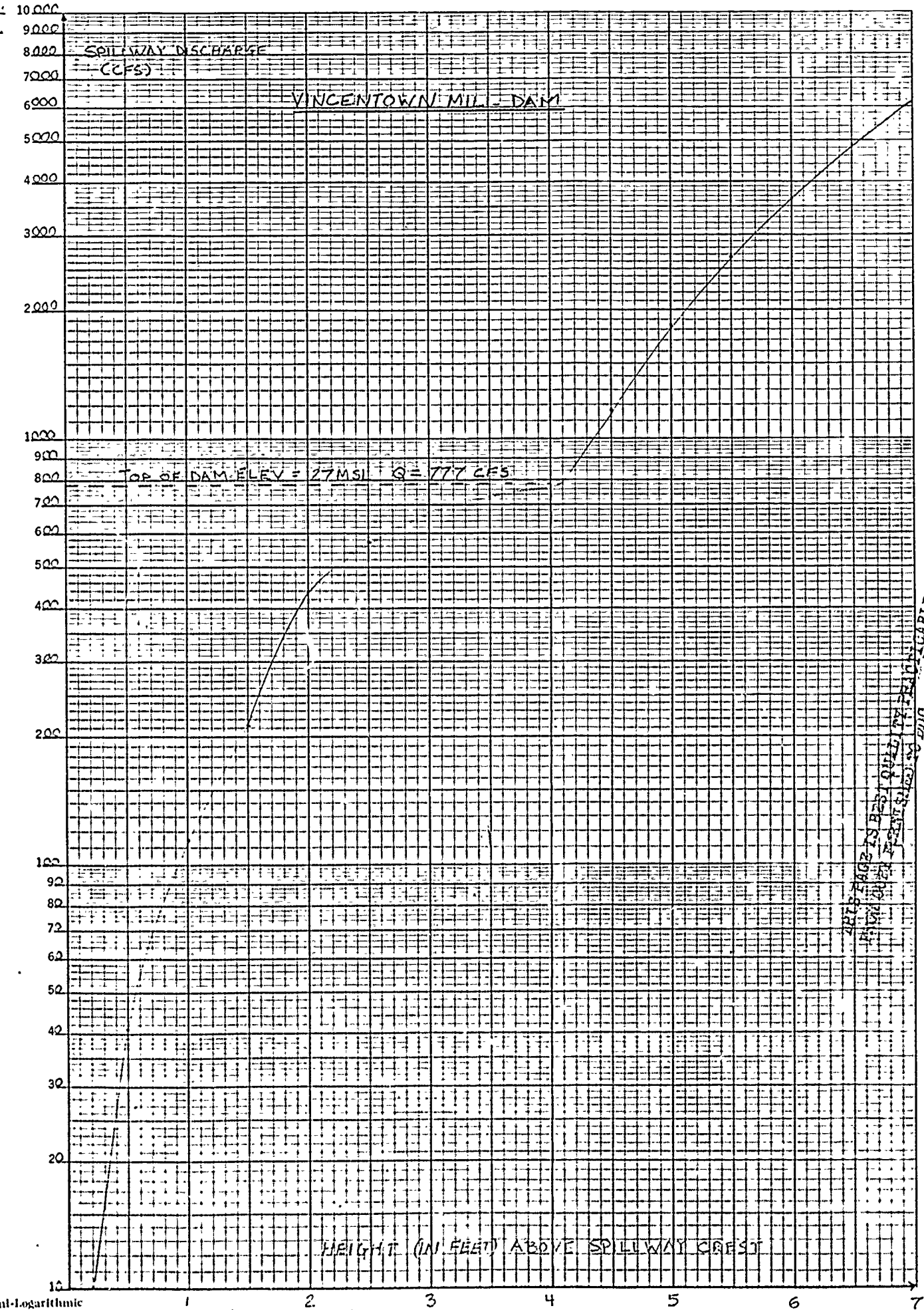
L = 400 - 57.5 = 342.5' L = 57.5

ELEV.	H	C	Q	H	C	Q
27	0					
27.5	0.5	2.8	339			
28	1	2.8	959			
28.5	1.5	2.8	1762			
29	2	2.8	2712			
29.5	2.5	2.8	3791	0.5	2.8	57
30	3	2.8	4983	1.0	2.8	161
30.5	3.5	2.8	6279	1.5	2.8	296
31	4	2.8	7672	2.0	2.8	455

TOTAL Q

ELEV.	H	ΣQ	
23	0	0	
23.5	.5	41	
24	1	115	
24.5	1.5	212	
25	2	438	
25.5	2.5	574	
26	3	672	
26.5	3.5	726	
27	4	777	TOP OF DAM
27.5	4.5	1163	
28	5	1826	
28.5	5.5	2672	
29	6	3664	
29.5	6.5	4837	
30	7	6171	
30.5	7.5	7638	
31	8	9224	

NATIONAL 12-183



Semi-Logarithmic

BY L.B. DATE
CHKD. BY DATE
SUBJECT SURCHARGE STORAGE

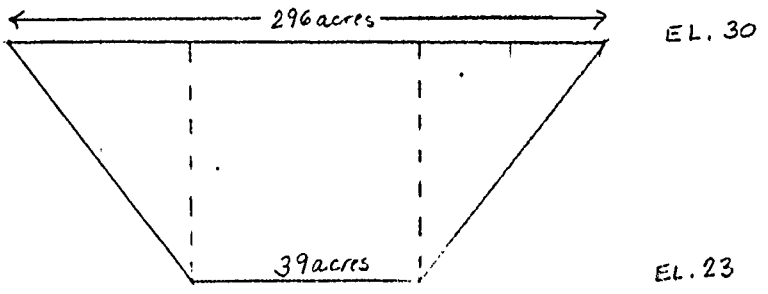
LOUIS BERGER & ASSOCIATES INC.

VINCENTOWN MILL DAM

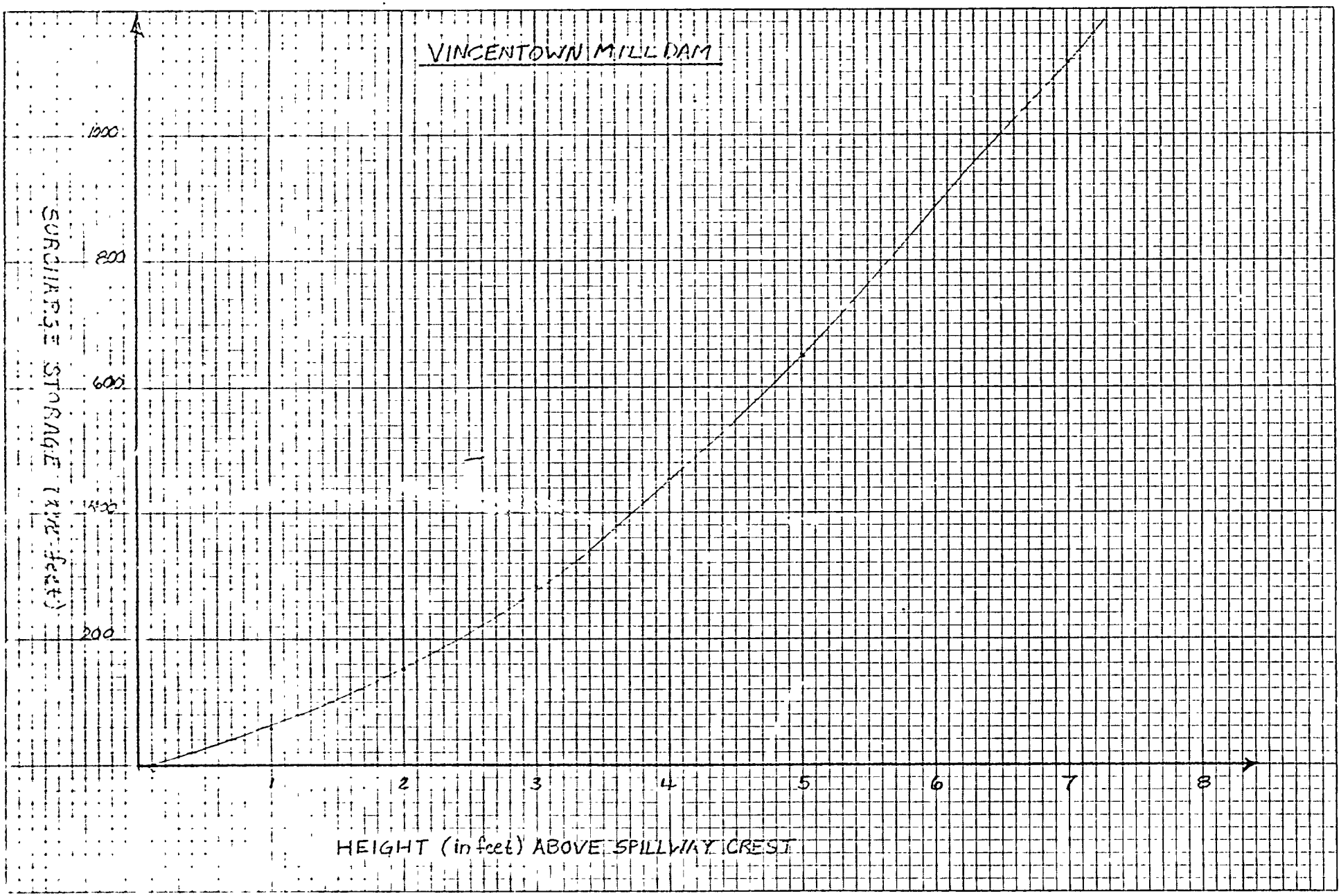
SHEET NO. A-5 OF.
PROJECT C-296

AREA OF LAKE = 39 acres @ EL. 23.0 MSL.

AREA OF 30' CONTOUR ≈ 296 acres



Elevation above Spillway (ft)	Storage (acre feet)
1.0	57
2.0	151
3.0	282
4.0	450
5.0	654
6.0	895
7.0	1172
8.0	1487



BY. L.B. DATE

CHKD. BY DATE

SUBJECT APPROXIMATE DRAWDOWN CALCULATIONS

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A7 OF

PROJECT C-246

VINCENTOWN MILL DAM

STORAGE AT NORMAL POOL = 107 acre-feet

AVAILABLE HEAD = 7 feet

ASSUME DRAWDOWN IN TWO STAGES WITH ALL FLASH-BOARDS REMOVED FROM MAIN SPILLWAY

ASSUME NO TAILWATER AND AN INFLOW OF 52 cfs

STAGE 1

$H = 5.25'$

$Q = CLH^{3/2} - 52 \qquad L = 23' \quad C = 3.1$

$Q = 3.1(23)(5.25)^{3/2} - 52$

$Q = 806$ cfs

$$\text{Time} = \frac{107 \text{ acre-feet} \times 43560 \text{ ft}^2/\text{acre}}{806 \text{ ft}^3/\text{sec} \times 3600 \text{ sec/hr} \times 2}$$

$= .8$ hours

STAGE 2

$H = 1.75'$

$Q = 3.1(23)(1.75)^{3/2} - 52$

$Q = 113$ cfs

$$\text{time} = \frac{107 \text{ acre-feet} \times 43560 \text{ ft}^2/\text{acre}}{113 \text{ cfs} \times 3600 \text{ sec/hr} \times 2}$$

$= 11.5$ hours

TOTAL DRAWDOWN TIME $= .8 + 11.5$

$= 12.25$ hours

```
A  VINCENTOWN MILL DAM
```

```
A  VINCENTOWN MILL DAM
A  BY  L  BAINES
A  JANUARY 1980
B    150       2
I      3
K      0       5                                                    1
1      INFLOW HYDROGRAPH
M      1       1      52                    52                    0.5
P      0    23.6      97      106      116      128
T                                                          0.5      0.1
W    13.1    0.25
X                     1
Y      1      55                                                    1
1    ROUTING THROUGH RESERVOIR
Y                            1
1      1
2      0      57     151      282      450      654      895     1172     1487
3      0     115     438      672      777     1826     3664     6171     9224
K     99
A
W
A
W
```

HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01

VINCENTOWN MILL DAM
BY L BAINES
JANUARY 1980

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	2	0	0	0	0	0	0	0	0

JOPER	NUT
3	0

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	52.00	0.00	52.00	0.00	0.500	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23 60	97.00	106.00	116.00	128.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.851

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 13.10 CP=0.23 NTA= 0

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR=1.00

CLARK DID NOT CONVERGE TO GIVEN SNYDER COEFFICIENTS
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.27 AND R=24.34 INTERVALS

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 13.13 HOURS, CP= 0.23 VOL= 0.98

30.	115.	238.	376.	497.	577.	597.	577.	554.	532.
510.	490.	470.	451.	433.	416.	399.	383.	367.	353.
338.	325.	312.	299.	287.	276.	264.	254.	244.	234.
224.	215.	207.	198.	190.	183.	175.	168.	161.	155.
149.	143.	137.	132.	126.	121.	116.	112.	107.	103.
99.	95.	91.	87.	84.	80.	77.	74.	71.	68.
65.	63.	60.	58.	55.	53.	51.	49.	47.	45.

43.	42.	40.	38.	37.	35.	34.	33.	31.	30.
29.	28.	26.	25.	24.	23.	22.	22.	21.	20.
19.	18.	18.	17.	16.	16.	15.	14.	14.	13.

END-OF-PERIOD FLOW

TIME	PAIN	EXCS	COMP Q
1	0.03	0.00	0.
2	0.03	0.00	0.
3	0.03	0.00	0.
4	0.06	0.00	0.
5	0.06	0.00	0.
6	0.06	0.00	0.
7	0.52	0.18	6.
8	1.07	0.87	47.
9	0.42	0.22	150.
10	0.04	0.00	301.
11	0.04	0.00	470.
12	0.04	0.00	620.
13	0.27	0.07	722.
14	0.27	0.07	761.
15	0.27	0.07	761.
16	0.60	0.40	769.
17	0.60	0.40	811.
18	0.60	0.40	903.
19	5.06	4.86	1179.
20	10.32	10.12	2032.
21	4.09	3.89	3717.
22	0.40	0.20	6030.
23	0.40	0.20	8521.
24	0.40	0.20	10682.
25	0.00	0.00	12077.
26	0.00	0.00	12523.
27	0.00	0.00	12308.
28	0.00	0.00	11886.
29	0.00	0.00	11437.
30	0.00	0.00	10986.
31	0.00	0.00	10545.
32	0.00	0.00	10120.
33	0.00	0.00	9713.
34	0.00	0.00	9322.
35	0.00	0.00	8946.
36	0.00	0.00	8586.
37	0.00	0.00	8241.
38	0.00	0.00	7909.
39	0.00	0.00	7590.
40	0.00	0.00	7285.
41	0.00	0.00	6991.
42	0.00	0.00	6710.
43	0.00	0.00	6440.
44	0.00	0.00	6181.
45	0.00	0.00	5932.
46	0.00	0.00	5693.
47	0.00	0.00	5464.
48	0.00	0.00	5244.
49	0.00	0.00	5033.

50	0.00	0.00	4830.
51	0.00	0.00	4636.
52	0.00	0.00	4449.
53	0.00	0.00	4270.
54	0.00	0.00	4098.
55	0.00	0.00	3933.
56	0.00	0.00	3775.
57	0.00	0.00	3623.
58	0.00	0.00	3477.
59	0.00	0.00	3337.
60	0.00	0.00	3202.
61	0.00	0.00	3074.
62	0.00	0.00	2950.
63	0.00	0.00	2831.
64	0.00	0.00	2717.
65	0.00	0.00	2608.
66	0.00	0.00	2503.
67	0.00	0.00	2402.
68	0.00	0.00	2305.
69	0.00	0.00	2212.
70	0.00	0.00	2123.
71	0.00	0.00	2038.
72	0.00	0.00	1956.
73	0.00	0.00	1877.
74	0.00	0.00	1802.
75	0.00	0.00	1729.
76	0.00	0.00	1659.
77	0.00	0.00	1593.
78	0.00	0.00	1528.
79	0.00	0.00	1467.
80	0.00	0.00	1408.
81	0.00	0.00	1351.
82	0.00	0.00	1297.
83	0.00	0.00	1245.
84	0.00	0.00	1194.
85	0.00	0.00	1146.
86	0.00	0.00	1100.
87	0.00	0.00	1056.
88	0.00	0.00	1013.
89	0.00	0.00	973.
90	0.00	0.00	933.
91	0.00	0.00	896.
92	0.00	0.00	860.
93	0.00	0.00	825.
94	0.00	0.00	792.
95	0.00	0.00	760.
96	0.00	0.00	729.
97	0.00	0.00	700.
98	0.00	0.00	672.
99	0.00	0.00	645.
100	0.00	0.00	619.
101	0.00	0.00	594.
102	0.00	0.00	570.
103	0.00	0.00	547.
104	0.00	0.00	525.

105	0.00	0.00	504.
106	0.00	0.00	484.
107	0.00	0.00	462.
108	0.00	0.00	432.
109	0.00	0.00	412.
110	0.00	0.00	396.
111	0.00	0.00	380.
112	0.00	0.00	364.
113	0.00	0.00	349.
114	0.00	0.00	334.
115	0.00	0.00	320.
116	0.00	0.00	302.
117	0.00	0.00	284.
118	0.00	0.00	268.
119	0.00	0.00	196.
120	0.00	0.00	60.
121	0.00	0.00	8.
122	0.00	0.00	5.
123	0.00	0.00	3.
124	0.00	0.00	0.
125	0.00	0.00	0.
126	0.00	0.00	0.
127	0.00	0.00	0.
128	0.00	0.00	0.
129	0.00	0.00	0.
130	0.00	0.00	0.
131	0.00	0.00	0.
132	0.00	0.00	0.
133	0.00	0.00	0.
134	0.00	0.00	0.
135	0.00	0.00	0.
136	0.00	0.00	0.
137	0.00	0.00	0.
138	0.00	0.00	0.
139	0.00	0.00	0.
140	0.00	0.00	0.
141	0.00	0.00	0.
142	0.00	0.00	0.
143	0.00	0.00	0.
144	0.00	0.00	0.
145	0.00	0.00	0.
146	0.00	0.00	0.
147	0.00	0.00	0.
148	0.00	0.00	0.
149	0.00	0.00	0.
150	0.00	0.00	0.
SUM	25.68	22.15	364660.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12523.	12303	10879.	7558.	364656.
INCHES		2.20	7.78	16.23	21.74
AC-FT		6104.	21589.	44999.	60305.

RUNOFF MULTIPLIED BY 0.50

0	0.	0.	0.	0.	0.	3.	24.	75.	150.
635.	310.	361.	381.	380.	384.	406.	451.	589.	1016.
1659.	3015.	4261.	5341.	6039.	6261.	6154.	5943.	5718.	5493.
5272.	5060.	4956.	4661.	4473.	4293.	4120.	3954.	3795.	3642.
3496.	3355.	3220.	3090.	2966.	2846.	2732.	2622.	2516.	2415.
2318.	2224.	2135.	2049.	1966.	1887.	1811.	1738.	1668.	1601.
1537.	1475.	1416.	1359.	1304.	1251.	1201.	1153.	1106.	1062.
1019.	978.	939.	901.	864.	830.	796.	764.	733.	704.
676.	648.	622.	597.	573.	550.	528.	507.	486.	467.
448.	430.	413.	396.	380.	365.	350.	336.	322.	309.
297.	285.	274.	263.	252.	242.	231.	216.	206.	198.
190.	182.	174.	167.	160.	151.	142.	134.	98.	30.
4.	3.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6261.	6151.	5439.	3779.	182328.
INCHES		1.10	3.89	8.11	10.87
AC-FT		3052.	10794.	22499.	30152.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
55	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IPES	ISAME
0 0	0 000	0.00	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0 000	0.000	0.000	0.

STORAGE=	0	57.	151.	282.	450.	654.	895.	1172.	1487.	0.
OUTFLOW=	0	115	438.	672.	777.	1826.	3664.	6171.	9224.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.	1.	0.
8	2.	13.	4.
9	8.	49.	17.
10	22.	113.	44.
11	43.	193.	87.
12	66.	272.	153.
13	92.	335.	234.
14	109.	371.	294.

15	120.	380.	333.
16	127.	382.	354.
17	132.	395.	372.
18	139.	429	397.
19	155.	520.	446.
20	207	803.	538.
21	341.	1437.	709.
22	570.	2437.	1395.
23	808	3638.	3002.
24	934.	4601.	4471.
25	1099.	5690.	5514.
26	1160.	6150.	6058.
27	1174.	6208.	6167.
28	1161.	6049.	6068.
29	1138	5831.	5865.
30	1114.	5606.	5643.
31	1069.	5383.	5420.
32	1065.	5166.	5203
33	1042.	4958.	4997
34	1020.	4759.	4792.
35	998.	4567.	4600.
36	978.	4383.	4414
37	958.	4207.	4237.
38	939.	4037.	4066.
39	921	3875.	3902.
40	904	3719.	3745.
41	887.	3569.	3601.
42	869	3425.	3465.
43	851.	3287.	3328.
44	833.	3155.	3194.
45	817.	3028.	3066.
46	800.	2906.	2942.
47	785	2789.	2824.
48	770	2677.	2710.
49	756.	2569.	2601.
50	742.	2466.	2496.
51	729.	2366.	2396.
52	716	2271.	2299.
53	704.	2180.	2207.
54	692.	2092.	2118.
55	681.	2008.	2033.
56	670.	1927.	1951.
57	660.	1849.	1872.
58	650	1775.	1804.
59	636.	1703.	1744.
60	625.	1635.	1679.
61	613.	1569.	1613.
62	600.	1506.	1549.
63	588.	1445.	1487.
64	576	1387.	1427.
65	565.	1331.	1370.
66	555.	1278.	1315.
67	544.	1226.	1262.
68	534.	1177.	1211.
69	525.	1129.	1162.

70	516.	1084.	1116.
71	507.	1040.	1071.
72	499.	998.	1028.
73	491.	958.	986.
74	483.	920.	947.
75	476.	883.	908.
76	466.	847.	872.
77	462.	813.	837.
78	455.	780.	803.
79	448.	749.	776.
80	439.	719.	770.
81	427.	690.	762.
82	411.	662.	753.
83	392.	635.	741.
84	372.	610.	728.
85	349.	585.	714.
86	325.	562.	699.
87	300.	539.	683.
88	275.	517.	659.
89	251.	497.	617.
90	231.	477.	581.
91	213.	457.	549.
92	197.	438.	521.
93	183.	421.	495.
94	170.	404.	472.
95	158.	388.	450.
96	147.	372.	425.
97	138.	357.	395.
98	132.	343.	372.
99	126.	329.	353.
100	122.	316.	337.
101	117.	303.	322.
102	113.	291.	308.
103	110.	279.	295.
104	106.	268.	283.
105	103.	257.	272.
106	99.	247.	261.
107	96.	236.	250.
108	93.	224.	238.
109	89.	211.	226.
110	86.	202.	216.
111	83.	194.	206.
112	81.	186.	197.
113	78.	178.	189.
114	76.	171.	181.
115	74.	163.	173.
116	72.	155.	165.
117	69.	147.	157.
118	67.	138.	149.
119	63.	116.	134.
120	53.	64.	107.
121	40.	17.	81.
122	29.	3.	59.
123	21.	2.	43.
124	15.	1.	31.

125	11.	0.	22.
126	8.	0.	16.
127	6.	0.	11.
128	4.	0.	8.
129	3.	0.	6.
130	2.	0.	4.
131	1.	0.	3.
132	1.	0.	2.
133	1.	0.	1.
134	1.	0.	1.
135	0.	0.	1.
136	0.	0.	1.
137	0.	0.	0.
138	0.	0.	0.
139	0.	0.	0.
140	0.	0.	0.
141	0.	0.	0.
142	0.	0.	0.
143	0.	0.	0.
144	0.	0.	0.
145	0.	0.	0.
146	0.	0.	0.
147	0.	0.	0.
148	0.	0.	0.
149	0.	0.	0.
150	0.	0.	0.
SUM			182328.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6187.	6104.	5401.	3752.	182328.
INCHES		1.09	3.86	8.06	10.87
AC-FT		3029.	10719.	22340.	30152.

********** ********** ********** ********** **********

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	5	6261.	6151.	5439.	3779.	52.00
ROUTED TO	55	6187.	6104.	5401.	3752.	52.00